This workshop, as reported by the authors, was a carefully planned and tightly organized way for introducing learners to useful tools and concepts—tailored to the target audience—in an efficient, interactive, and engaging manner.—**Eugene C. Nelson, DSc, MPH, Director, Quality Education, Measurement and Research, Lahey Hitchcock Clinic, Lebanon, New Hampshire**

HEALTH PROFESSIONS EDUCATION

Teaching Medical Faculty How to Apply Continuous Quality Improvement to Medical Education

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How do medical faculty improve a course that has been taught the same way for years, change a deeply rooted system of administration, or improve on the delivery of clinical care? The process of affecting change in medical education requires skills in working together as teams, in approaching the work environment as a system, and in learning how to create positive change.[1] When presented with opportunities for improving outdated educational content, ineffective teaching methods, inefficient administration, and/or undesirable variation in clinical care, health profession educators can benefit from applying a process that helps identify what needs to be changed and provides a framework for testing change.

For example, consider the process of taking a patient's history. Without prior coaching, a new medical student who is a good listener could sit with the patient and get most of the history. However, we all recognize that it is much better to teach how to follow a specific structured process. A framework minimizes omissions, provides a detailed plan, and reduces undesirable variation. Knowledge and skill in continuous improvement provides medical faculty a similar structure for testing and implementing change.

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Article-at-a-Glance

Background: An eight-hour workshop was conducted at a professional meeting in 1996 to introduce medical faculty to the principles of continuous quality improvement (CQI) as they relate to change in medical education and to provide participants with opportunities to use specific tools for applications to education. Four two-hour sessions focused on an introduction to CQI, understanding and mapping processes, identifying change ideas, and testing a change for improvement.

Testing a change for improvement: The goals of the final session were to plan a pilot test of an improvement, identify the steps of the plan-do-study-act (PDSA) cycle, and consider change for improvement in the context of one's own organization. Working in small groups, participants chose a specific change one might try in the following example: improving student performance in a neuroscience course.

Postsession evaluation and follow-up: Immediately following the workshop sessions, participants represented by administrators in medical education and clinical and basic science teaching faculty completed evaluations on the usefulness and likelihood of their using CQI tools. One year later, of the 32 workshop registrants who were mailed surveys, 15 respondents rated their change in understanding of CQI and their use of CQI techniques. More than 60% of the respondents reported application of CQI principles at their organizations. CQI methods used most frequently included structured team meetings, prioritizing opportunities, and brainstorming.

Conclusion: The significant application of CQI principles and methods reported by participants one year after a brief intervention supports a need and utility for CQI principles and tools in medical education.

Both the Council on Graduate Medical Education[2] (Rockville, Md) and the Pew Health Professions Commission[3] (San Francisco) recommend that continuous improvement be included in health professions education to prepare for work in contemporary health care environments. This engenders a need for faculty development, especially in medical education, where continuous improvement has not been part of most schools' curricula.

The authors—the members of the Special Interest Group on Continuous Quality Improvement in Medical Education—conducted an eight-hour workshop titled "Faculty Skills in Applying Continuous Quality Improvement to Medical Education" at the 1996 spring meeting of the Central Group on Educational Affairs (CGEA) of the Association of American Medical Colleges.[4] The CGEA is a regional organization of 34 centrally located medical schools from 12 states and Canada whose purpose is to encourage and facilitate communication among members—who include administrators in medical education and clinical and basic science teaching faculty—to provide a forum for discussion of medical education matters. Representatives from 18 medical schools in 8 states registered for the workshop.

The overall theme for the 1996 CGEA meeting was "Faculty Skills for the 21st Century." The goal of the meeting was to provide each participant with a set of new and/or improved skills. The meeting was organized into six tracts so that anyone wishing to focus on one specific area could do so without scheduling conflicts. However, participants were invited to select workshops from any track as their needs indicated. Our workshop series was one of the six tracts. Our goal was to provide faculty with a framework for making changes in medical education. The purpose of the workshop was twofold. First, we introduced faculty to the principles of continuous quality improvement (CQI) as they relate to change in medical education. Second, we provided participants with opportunities to use specific tools for educational applications of continuous improvement, including how to run an effective meeting.

In this article we describe the workshop presented at the meeting and report on the results of a one-year follow-up survey on the participants' application of CQI principles and use of CQI methods.

Principles of CQI

CQI is a set of concepts, principles, and methods elucidated by W. Edwards Deming, Joseph Juran, and others.[5] It involves the application of the scientific method, through serial experimentation with the goal of meeting the needs of those we serve. In recent years CQI has been adapted to health care delivery[6] and to education.[7,8]

Table 1. Criteria for Suitability of a CQI Effort in Medical Education*

The problem or process of improvement should

- be important both to the people being served and to the people who work in the process. In education, these may include students, faculty, administrators, and others involved in the process being improved.
- be clearly linked to the overall goals of the organization. In medical education, the organizational level of the project determines whether the goals are linked to clerkships, departments, the school, and/or the university.
- merit the investment of resources needed to undertake the project. Resources in education include students, professional time, staff support, physical space, audiovisual equipment, computer hardware and software, real and simulated patients, videotaping, books, and other reading materials.
- be manageable in size. Too broad or difficult a problem may impede success. Reform of an entire curriculum may be too much, especially at first, but the implementation or improvement of a single course may be achievable.
- lend itself to rapid measurement so that the effects of interventions can be determined quickly. Changes in the medical education process may require measures of student performance, student and faculty satisfaction, and cost. Learning is accelerated when measurement (and therefore feedback) occurs frequently.

* *CQI, continuous quality improvement.*

Fundamental concepts of CQI include the following:

1. Success is achieved by meeting the needs of those we serve;

2. Most problems originate in processes or systems and not in people;

3. Unintended variation in processes can lead to undesirable variation in outcomes; and

4. Serial experimentation can be used to achieve continuous improvement.

The CQI process involves a learning cycle, the plan-do-study-act (PDSA) cycle, in which

P = planning a change we believe will improve the system;

D = doing (implementing) the change, often on a small scale;

S = studying the effect of the change; and

A = acting to hold the gain or improve the process further.

A successful model for improvement demands that we be clear about what we want to accomplish and how we will know a change is an improvement.[9]

Application to Medical Education

CQI methodology has been applied to various processes in predoctoral medical education, including both discipline-oriented and interdisciplinary courses[10]; development, design, and revision of curriculum[11]; improvement in learning environments[12]; reviews of medical school education by the LCME (Liaison Committee on Medical Education)[13]; and ambulatory teaching in medical schools.[14] CQI can be used in similar processes in postdoctoral medical education, for example, residency training programs.[8,15]

Certain criteria help determine which problems will lend themselves to a CQI effort in medical education (Table 1, left).

Workshop Design

Four two-hour sessions, split between morning and afternoon sessions on two consecutive days, focused on the following topics:

- Introduction to CQI;
- Understanding and mapping processes in medical education;
- Identifying change ideas; and
- Testing a change for improvement.

The workshop was designed so that participants would benefit most from attending all modules in succession but would not be disadvantaged if they elected to participate in only selected sessions. Participants were administrators in medical education and clinical and basic science teaching faculties.

The workshop faculty included a dean of academic affairs and an associate dean of educational affairs [A.E.L., J.X.T.] and two academic physicians in primary care [M.T.C., L.A.H.]. Workshop sessions were conducted in a small classroom, in which participants and facilitators gathered in groups at tables equipped with flipcharts. Session participants were given handouts of slides used to deliver key points as well as a detailed example, an improvement project in medical education that focused on improving the student clinical learning environment.

Session 1: Introduction to CQI

The goals of the first session were to define CQI, identify the starting points of a CQI project, and show how to use a structured meeting process.

The faculty reviewed criteria for choosing an improvement project (Table 1). In small groups, participants analyzed three scenarios offered as possible improvement initiatives in medical education. The first scenario depicted a situation in which the dean of the medical school is upset that an article in *U.S. News & World Report* does not rank his or her medical school in the top 20 medical schools among residency directors in preparing students for primary care. The dean calls for a faculty task force to improve the school's national standing in this area. The second scenario described a situation in which the chair of the curriculum committee proposes a general review of the medical school curriculum. There are no current, apparent issues (for example, the recent LCME review offered no significant criticism, student enrollment is up, and graduate responses on the Association of American Medical Colleges survey conducted in January 1998 are favorable). The chair feels that a review would be a useful exercise for a subcommittee. In the third scenario, a department chair asks the new director of the pediatric clerkship to address declining student enrollment (which contrasts with the clerkship site's former status as consistently the most popular, always with a waiting list). Currently, 25% of student positions go unfilled during each clerkship period. The workshop participants rated each of the three scenarios according to the criteria for choosing an improvement project and chose one as most strategic.

At the same time, each small group practiced using a process for efficient team meetings. A structured, timed agenda led participants through the following meeting steps:

1. Assign roles;
2. Clarify the objective;
3. Review the agenda;
4. Work through the agenda items;
5. Summarize the content of the meeting;
6. Develop the agenda for the next meeting; and
7. Evaluate the meeting.[16]

This meeting format was carried over to small workgroups throughout the rest of the workshop.

Session 2: Understanding and Mapping Processes in Medical Education

The second session presented a tool that is used to create an image of a process—flowcharting. The purposes of flowcharting are to create a way to examine how the steps in a process relate to one another, to define the boundaries of a process, and to identify the working relationships of individuals involved in the process (the so-called customer–supplier relationships). The symbols used in flowcharting were described, and the steps in constructing a flowchart were explained. An example of a flowchart in a medical education project was presented.

Participants, divided into small groups, then engaged in a flowcharting exercise. The exercise was conducted as a structured CQI team meeting with assigned roles, time limitations, and team evaluation of the process. Each small group used a narrative paragraph describing the process of presenting and evaluating a neuroscience course (Sidebar 1, p 644) to construct a flowchart, similar to that of the author-prepared version (Figure 1, p 645).

Session 3: Identifying Change Ideas

In the third session, two methods to identify change ideas were introduced: structured brainstorming and cause-and-effect diagrams. Participants in small groups were instructed to apply these tools to generate ideas for improvement in a scenario regarding medical education. The first part of the session involved a brief introduction to the why, how-to, and rules of structured brainstorming. Participants were asked to use a team-meeting format (presented in Session 1) in which the main agenda item was to brainstorm causes of poor student performance in a neuroscience course. Participants practiced structured brainstorming using self-adhesive notes to record and display ideas, summarized in Table 2 (p 646).

In the second part of Session 3, a cause-and-effect diagram was explained, including its purpose and the rules for construction. Each small group determined labels for major categories of the sample scenario by clustering self-adhesive notes of causes of poor student performance and letting categories emerge. They then inserted the major categories as labels onto a cause-and-effect diagram, similar to the author-generated version (Figure 2, p 647).

Sidebar 1. Sample Narrative Scenario for Improving Student Performance in Neuroscience*

Three years ago the chairs of anatomy and physiology at a medical school decided they wanted a neuroscience course, as did other medical schools in Ohio. The chair of anatomy told the course director for neuroanatomy to meet with the appropriate faculty member from physiology and create a neuroscience course. Neuroanatomy was a stand-alone course in the curriculum, and neurophysiology was part of the medical physiology course. The curriculum committee gave the two faculty members a three-week block of time to schedule the course. The faculty members met and discussed whether to reduce the amount of material in the course to fit into the allotted time or maintain the current content. They decided to save themselves work by simply combining the existing content of their courses, which amounted to 96 contact hours. The physiologist insisted on presenting her material first because that was her normally scheduled week to lecture and she did not want to disrupt her research.

The course began with one week of physiology lectures followed by three weeks of neuroanatomy lectures and labs. About halfway through the course, after students complained about the lack of clinical content, a neurologist was invited to present the final two neuroanatomy lectures. One multiple-choice question examination was administered at the end of the course to determine student grades. Each faculty member generated his or her own questions separately for the exam and submitted them to the anatomy secretary. Student performance in the course was poor, with a large number of failures and low scores on the neuroscience section of the USMLE (United States Medical Licensing Exam). Students complained that they did not know what was expected of them in the course and that the sequence of presentations was confusing. They did not understand how all the information fit together and could not see the clinical relevance of the material in the course. They also felt that there was little opportunity to discuss these issues with the faculty. The faculty considered all this information in planning the course for the following year.

* *Adapted from an actual situation.*

Session 4: Testing a Change for Improvement

The goals of Session 4 were to plan a pilot test of an improvement, identify the steps of the PDSA cycle, and consider change for improvement in the context of one's own organization. Continuing to work in small groups, participants chose a specific change one might try in the example previously introduced: improving student performance in a neuroscience course. Ideas for improvement came from the brainstorming and categorization completed in the previous session.

Next, using the improvement model of Langley et al,[17] as presented in Nelson et al's worksheet,[18] participants answered the following questions for the change they chose to test:

- Aim: What are we trying to accomplish? (for example, our aim is to improve the performance of students in neuroscience by...)
- Measures: How will we know that a change is an improvement?
- Selected change: How would we describe the change we have selected for testing?

In addition, participants considered the steps of the PDSA improvement cycle itself[18,19]:

- Plan: How shall we plan the pilot? (Who does what? When? With what tools and training? What data are to be collected? How?)
- Do: What are we learning as we do the pilot?
- Study: As we study what happened, what have we learned?
- Act: As we act to hold the gains or abandon our pilot test efforts, what needs to be done?

Reconvening the large group, the faculty asked participants to turn from the theoretical to the real: What are the issues to consider if they wish to make change in medical education at home? The participants reviewed known drivers of change[20]:

- Tension for change;
- A perception that the proposed change is superior and achievable;
- The presence of knowledge and skills to do things differently; and
- Access to needed resources, including technical help and social support for new behaviors.

The participants then identified supports and barriers to change in their own organizations, using a force-field analysis (in which factors that promote or hinder the task at hand are listed in two opposing columns).[21]

Postsession Evaluation and One-Year Follow-Up

At the end of each session, participants were asked to complete written evaluations. Using a Likert scale of 1

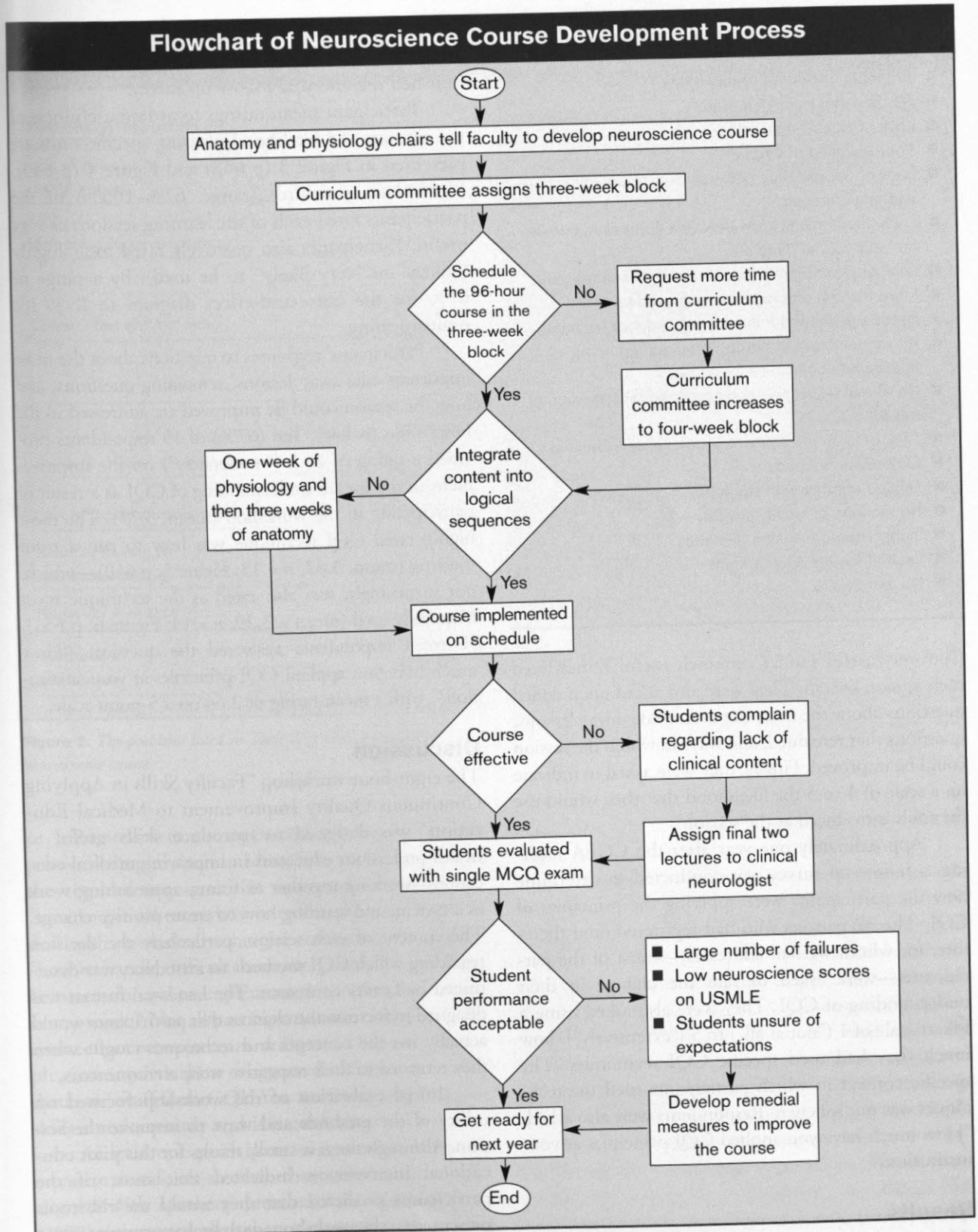

Figure 1. *This flowchart depicts the process by which a neuroscience course was to be developed. MCQ, multiple-choice question; USMLE, United States Medical Licensing Exam.*

Table 2. Samples of Problems in a Neuroscience Course Identified by Brainstorming

- Students unclear of expectations
- Students do poorly on exam
- Lack of clinical material
- Poor planning of course
- Lack of coordination between curriculum committee and chairpersons
- Lack of communication between curriculum committee and course directors
- Lack of prioritizing between research and teaching
- More training on proper testing needed
- Feedback needed from students sooner in course
- No formal decision-making process regarding appropriate objectives for course
- No formal decision-making process for formation of course
- Lack of team involvement in course development
- Objectives not clear
- Limited contact with students
- No mention of faculty evaluation
- Inappropriate teaching demands
- Lack of faculty development
- No team skills

("not very useful") to 5 ("extremely useful"), they rated each session overall. They were also asked open-ended questions about the most important take-away lessons, questions that remained, and ways in which the session could be improved. Finally, they were asked to indicate on a scale of 1 to 5 the likelihood that they would use the tools introduced at the session.

Approximately one year after the CGEA meeting, a follow-up survey was conducted to determine how the participants were applying the principles of CQI. The 32 persons who had registered (and therefore, for whom we had addresses)—most of the participants—were asked to rate the change in their understanding of CQI. They were also asked using a Likert scale of 1 ("not at all") to 5 ("extensively"), how much they had used specific CQI techniques. The specific context in which participants used the techniques was not solicited. Respondents were also asked, "How much have you applied CQI principles at your institution?"

Results

Of the 32 workshop participants, the number completing evaluations in each of the four sessions was 15, 20, 9, and 8, respectively. Some of the participants attended more than one session. Fifteen registrants returned the one-year follow-up survey.

Participant mean ratings regarding usefulness of the sessions and likelihood of using specific tools are presented in Figure 3 (p 648) and Figure 4 (p 649). More than two-thirds (range, 67%–100%) of the participants rated each of the learning sessions as very useful. Participants also positively rated tools highly ("likely" or "very likely" to be used), by a range of 67% for the cause-and-effect diagram to 89% for brainstorming.

Participants' responses to questions about the most important take-away lessons, remaining questions, and how the session could be improved are addressed in the Discussion (below). Ten (67%) of 15 respondents provided a rating of ≥ 3 ("moderately") on the improvement in the overall understanding of CQI as a result of participation in the workshop (mean, 3.73). The most highly rated CQI technique was how to run a team meeting (mean, 3.62, $n = 13$; Figure 5, p 650)—which, not surprisingly, was also rated as the technique most frequently used (mean = 3.29, $n = 14$; Figure 6, p 651). Fourteen respondents answered the question, "How much have you applied CQI principles at your institution?" with a mean rating of 2.64 on a 5-point scale.

Discussion

The eight-hour workshop "Faculty Skills in Applying Continuous Quality Improvement to Medical Education" was designed to introduce skills useful to health professions educators in improving medical education—working together as teams, approaching work as a system, and learning how to create positive change. The content of each session, particularly the decision regarding which CQI methods to introduce, was determined by faculty consensus. The hands-on format was designed to increase the chances that participants would actually use the concepts and techniques taught when they returned to their respective work environments.

Initial evaluation of the workshop focused on utility of the methods and ways to improve the session. Although the n is small, results for this pilot educational intervention indicated that most of the participants predicted that they would use the tools presented in the workshop, with brainstorming (89%) the most likely to be used and the cause-and-effect diagram (67%) the least likely.

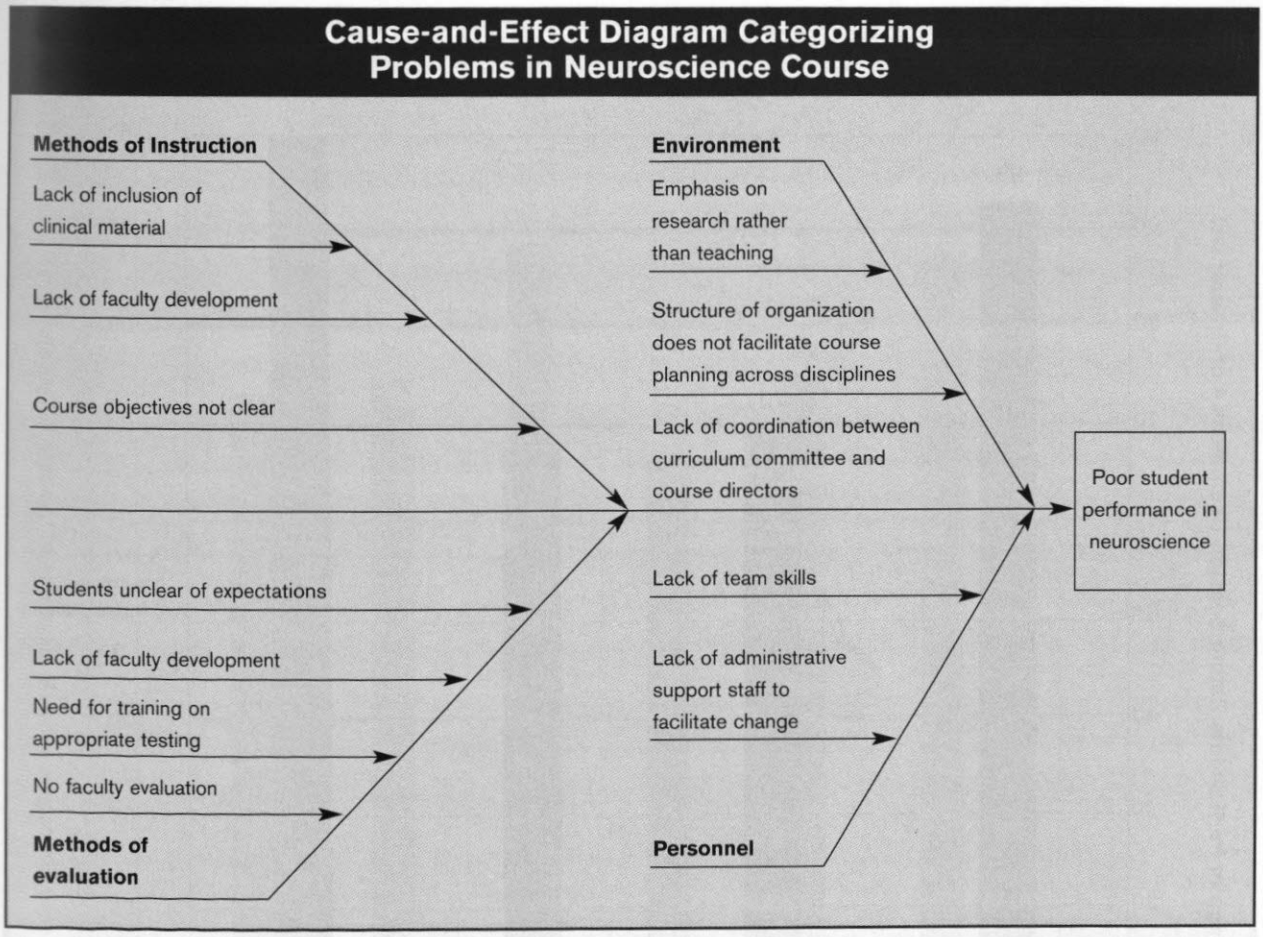

Figure 2. *The problems listed in Table 2 (p 646) are reflected in this cause-and-effect diagram of the causes of poor student performance in a neuroscience course.*

Responses to the open-ended questions in the postworkshop evaluation identified several issues. For the respondents, questions appeared to remain on "how to get others to buy in to the process," "how to deal with emotionally charged committee members," "how to handle difficult moments," and "the ability to be successful and to implement this method of change in my work." Not all participants were clear about the connection between team skills and CQI. For example, one participant suggested, "Separate 'team dynamic' stuff from CQI. You are trying to teach two skills simultaneously and it is confusing."

At least one participant suggested the need to organize handouts so that they were more closely aligned with speakers' presentations. Some participants commented that they also needed more time within the sessions for practicing the methods (even though, prompted by feedback from a pilot of the workshop, we had already increased the allotted time).

Participants' postworkshop take-away lessons addressed the usefulness of the tools (for example, "the meeting structure...makes for efficiency and actually stimulates creativity"; "importance of flowcharting in decision making process"; and "usefulness of brainstorming and fishbone [cause-and-effect] diagram for identifying problems and solutions." Yet take-away lessons from some participants suggested an understanding that continuous improvement is not just a set of tools (for example, to improve dull, unproductive meetings) but that it involves a structured approach to change. Some other, related comments referred to the "importance of criteria (for choosing an improvement process) and need for group involvement (in determining the criteria)" and the "importance of the appropriateness of team members."

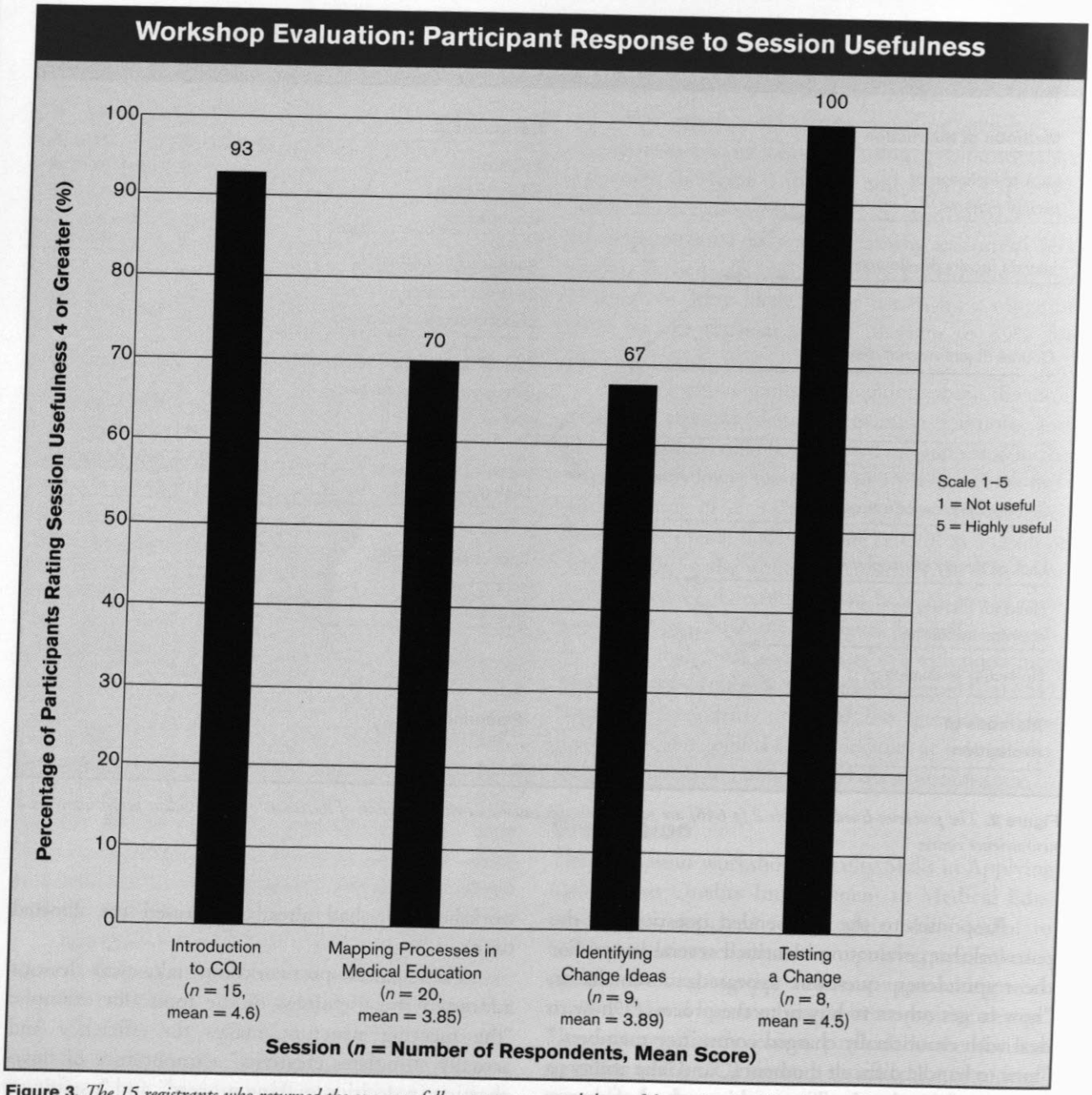

Figure 3. *The 15 registrants who returned the one-year follow-up survey rated the usefulness of each of the four two-hour workshop sessions.*

Individual comments from several participants illustrated an understanding of the usefulness of CQI in making change:

- "Making a process visual freezes it in time and space so people can examine/reflect/act";
- "The process requires structure to be creative";
- "Valuable...in organizing my own thinking and activities"; and
- "Careful design of pilot is useful in producing successful intervention."

Results from the one-year follow-up survey, which included questions about the learning and application of CQI tools, are limited by the fact that we did not have information on how to contact all the participants. Moreover, the response rate of 47% (15 of 32) was low. In addition, we addressed questions about all four sessions to anyone who participated in any of the sessions. Finally, we asked participants whether they had applied CQI principles but did not ask participants about whether they had pursued or obtained additional exposures to CQI.

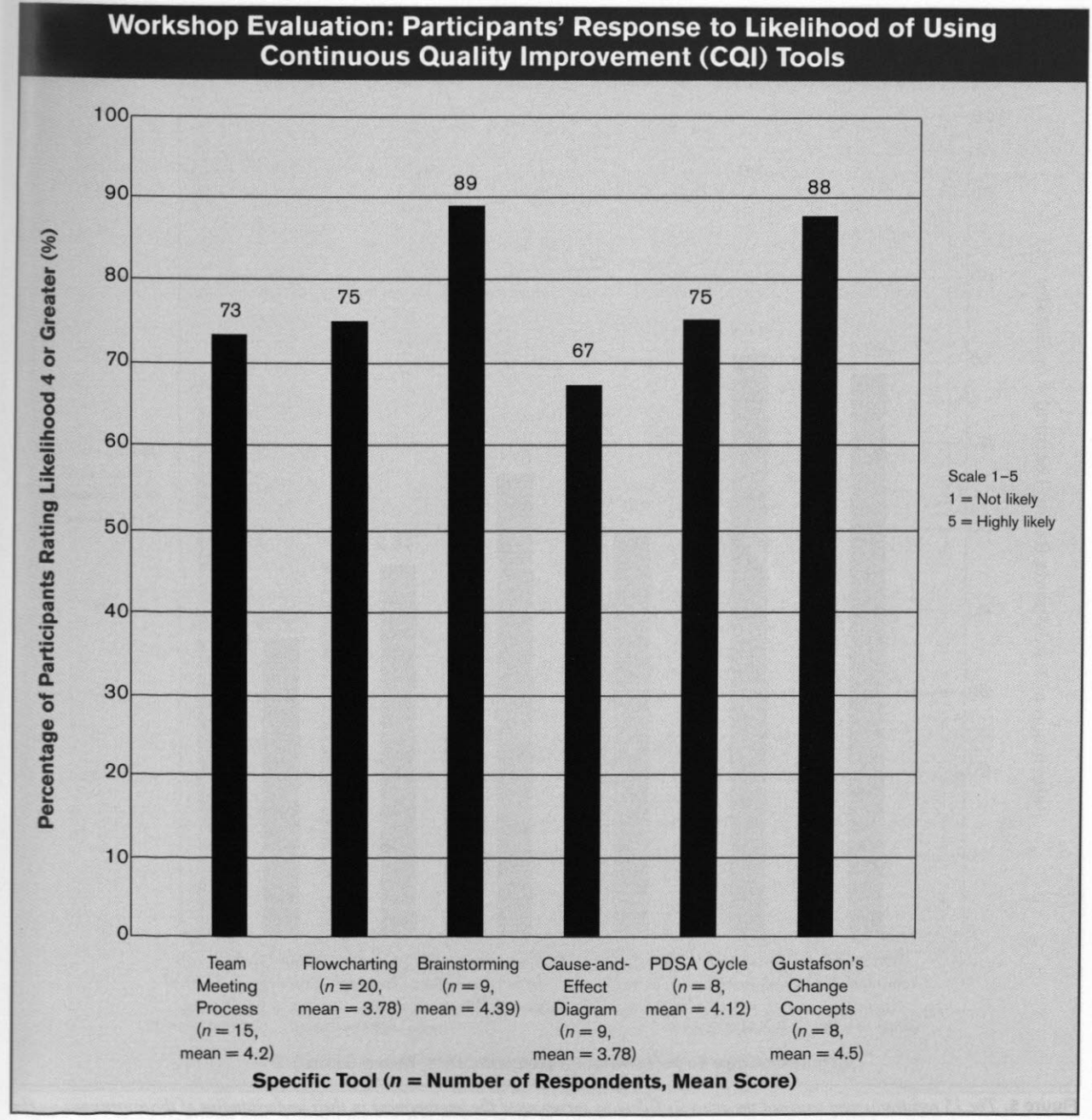

Figure 4. *The 15 registrants who returned the one-year follow-up survey rated the usefulness of each of the CQI tools presented in the workshop.*

Moreover, like most self-assessment evaluations, our self-reported outcome data are limited by errors in memory, personal bias, and external environmental factors affecting participants when completing the survey. In addition, the workshop represented a single-shot educational intervention in a single location and involving a small number of participants. However, since self-assessment remains the major vehicle for evaluation of educational programs, and many faculty must rely on workshop formats to learn new skills, we feel our approach was reasonable.

It is encouraging that most of the respondents to the follow-up survey indicated that they had applied CQI principles and tools at their organizations. However, in the absence of direct observation or a description of actual deployment of tools, we have no way to know conclusively whether or not participants changed their work based on our intervention.

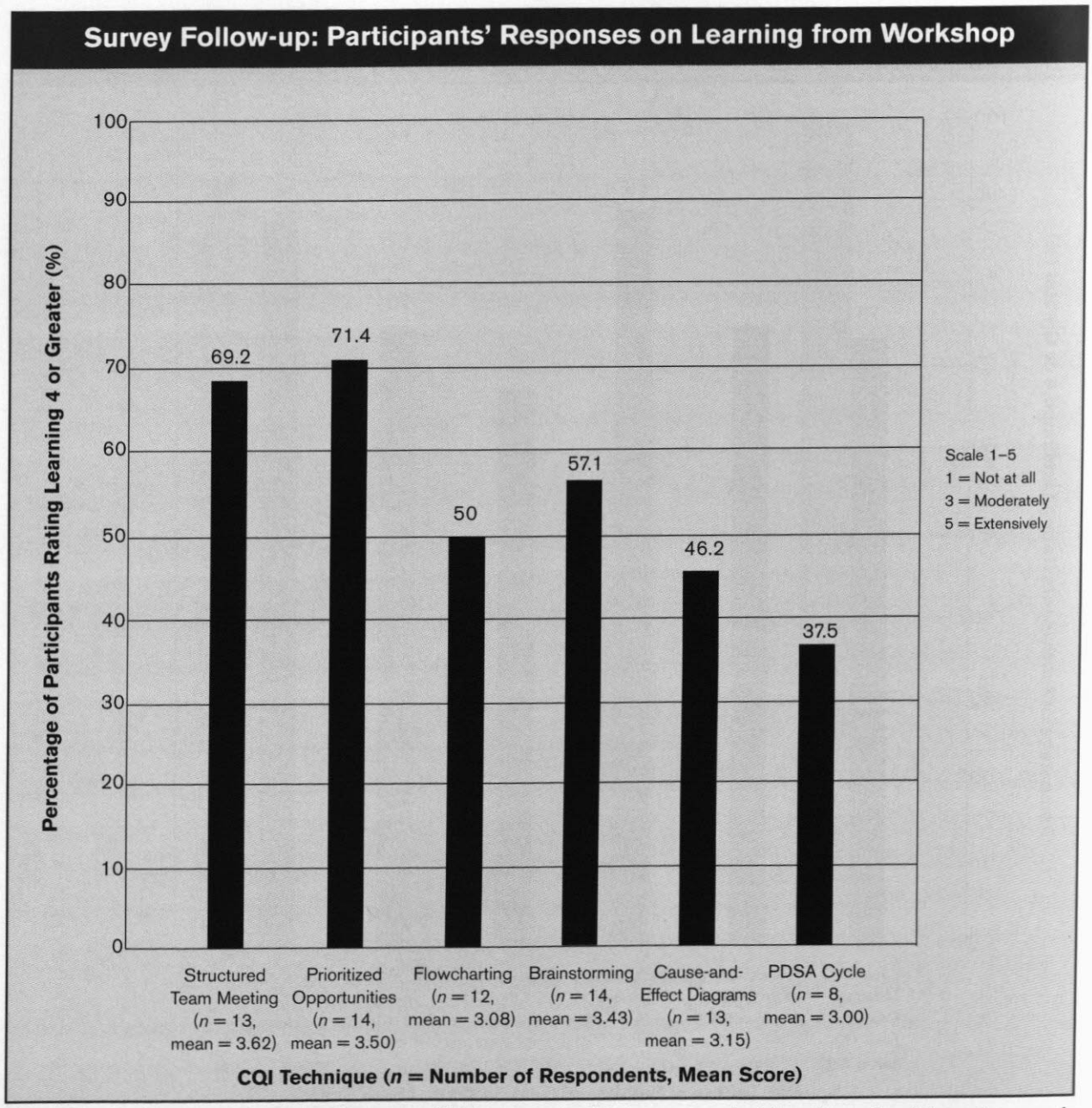

Figure 5. *The 15 registrants who returned the one-year follow-up survey rated the improvement in their understanding of the continuous quality improvement (CQI) techniques presented in the workshop.*

Despite the above limitations, participants in the workshop indicated an increase in understanding of CQI. The use of certain skills needed to bring about effective changes, such as running an effective team meeting, prioritizing opportunities for change, and brainstorming, were being used by a large percentage of respondents one year later (even if it was less than the immediate postsession assessment of potential tool utility would have suggested).

The fact that the PDSA cycle, an approach designed to assist in bringing about positive change, was rated as less useful than the other methods introduced in the workshop is surprising, insofar as the PDSA cycle is widely considered to be at the core of CQI. We did not ask the participants if they had actually made changes in medical education after returning home. The power of PDSA or a learning cycle approach is likely to be apparent only to those actually implementing change. It may

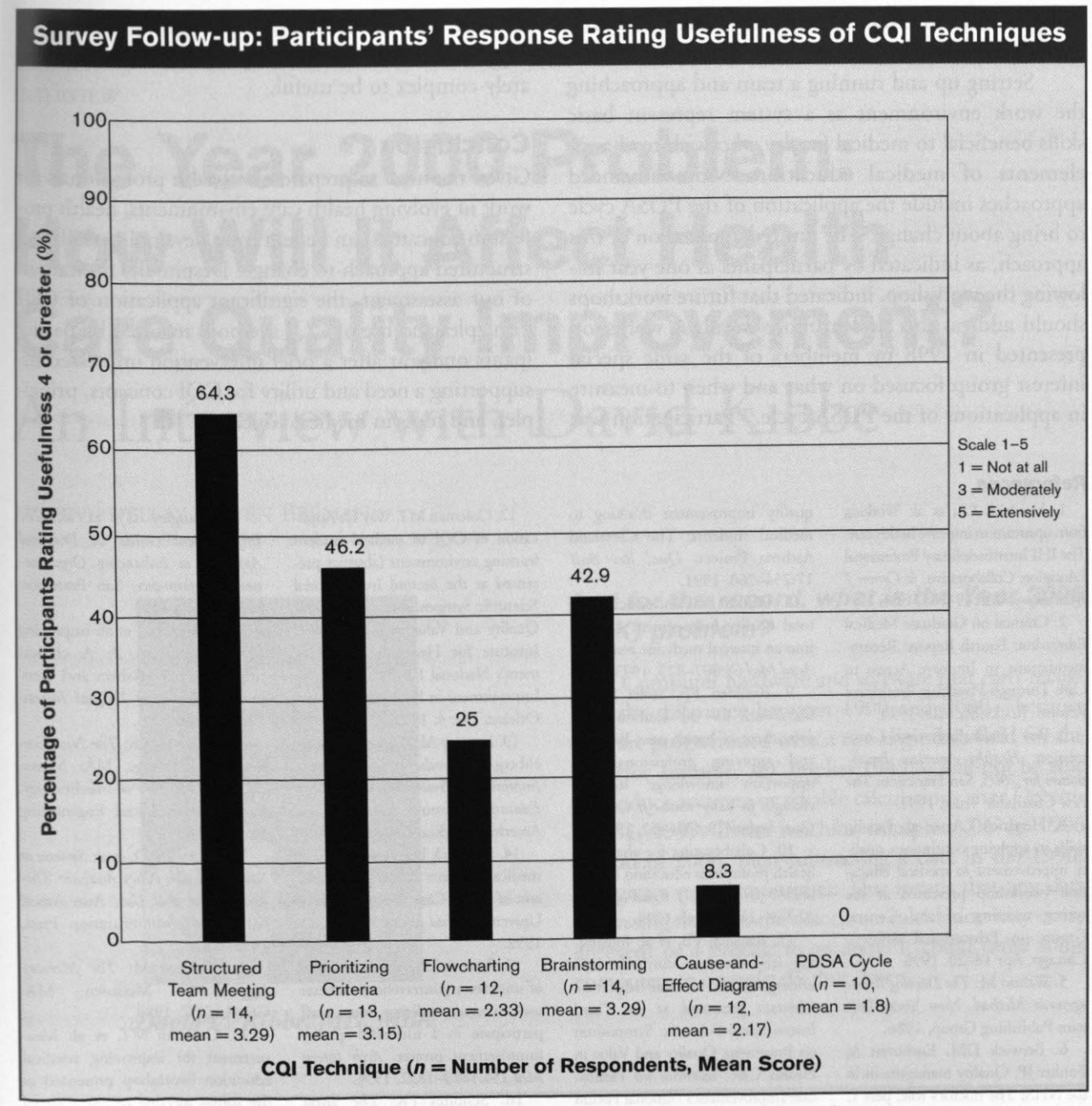

Figure 6. *The 15 registrants who returned the one-year follow-up survey rated the usefulness of the CQI techniques.*

be that a more experiential approach with an opportunity to make change and review the results is needed to clarify the importance of this core concept.

Considerations for Improvement

To optimize learning, there must be ample time for participants to practice. Although our participants were organized into groups of 4 or 5, in at least one session with 20 participants, we had 6 or more per group. It may be helpful to limit the size of small groups to 4 or 5 to provide participants enough time to process content and to fully participate.

Because of the complexity of the content, it is helpful to have handouts that match the order of the overhead presentation, as suggested by participants' responses. Problems presented as examples must be sufficiently complex to illustrate the usefulness of the concept or method to be demonstrated, but not so

complex as to lose the participants in the details and create frustration.

Setting up and running a team and approaching the work environment as a system represent basic skills beneficial to medical faculty who wish to change elements of medical education. More advanced approaches include the application of the PDSA cycle to bring about change. The limited application of this approach, as indicated by participants at one year following the workshop, indicated that future workshops should address this skill in more detail. A workshop presented in 1998 by members of the same special interest group focused on what and when to measure in applications of the PDSA cycle.[22] Participation was limited to six members per group. Feedback suggested that the problems presented were appropriately complex to be useful.

Conclusion

Given the need to prepare new health professionals for work in evolving health care environments, health profession educators can benefit from developing skills in a structured approach to change. Despite the limitations of our assessment, the significant application of CQI principles and use of CQI methods reported by participants one year after a brief intervention impressed us, supporting a need and utility for CQI concepts, principles, and tools in medical education. J

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